N FIXATION BY LOCAL BEAN CULTIVARS UNDER UGANDA SOIL CONDITIONS.

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Introduction: Common bean (Phaseolus vulgaris,L.) production in Uganda is greatly limited by soil fertility constraints particularly N, P and K. Supplying these nutrients by use of inorganic fertilizers still remains unaffordable to most farmers. Most expensive of these nutrients and liable to heavy losses once applied is N. Legume inoculation is still unpopular within Uganda. The crop nodulates freely (Jjemba and Male-Kayiwa, unpublished). The fixation potential by a wide range of cultivars has not been investigated. This study was conducted to compare a few acceptable local cultivars for N_2 fixation to those widely used elsewhere and also quantify N fixed by beans within this region.

Materials and Methods: Seed of 9 local or introduced cultivars (Table 1) were planted on a low N and P oxisol (pH 5.7; 0.17 %N; 4 ppmP by the double acid method and 4.5 meq Ca/100g soil). A split plot design with 4 replicates was planted on 18th Sept, 1991 where amending or not amending with P and K were the main plots and cultivar types the sub-plots. 125 Kg SSP/ha and 100 Kg Potash/ha P and K respectively were broadcast before planting. N fixed was quantified by ^{15}N methodology with both millet and sorghum as reference crops. Plot size was 1.8mX1.2m with 3 rows at 60cm apart. Intrarow spacing was 10cm for beans and millet and 30cm for sorghum. ^{15}N application was within 10cm on either side of the middle row at 10KgN/ha, 10% ^{15}N a.e for beans and 50KgN/ha, 1% ^{15}N a.e. $(NH_4)_2SO_4$ for the references.

Inoculation was at planting and 19 DAP with 10^9 cells/mL of Rhizobium leguminosarum bv tropici strain CIAT 899. Data included days to 50% flowering and to physiological maturity (p.m), shoot and pod dry weight at p.m. and ^{15}N a.e. The weighted a.e. was used to calculate N fixed using the A-value approach (Hardarson and Danso, 1990).

Results and discussion: Flowering duration ranged between 46 and 54 DAP with the small-seeded types generally flowering later. This type also matured late (Table 1) and there was a strong correlation ($r=0.78^{**}$)between maturity and seed size. This may have a significant bearing on the former group's ability to fix N as they have a longer N accumulation lifespan. Total N and N fixed also differed ($p<0.05$) between cultivars (Table 2).

Both Riz103 and Mutike are potential parental lines in a breeding program towards enhancing N fixation. Riz103 significantly out-yielded all the local cultivars except Mutike. The bean cultivar by soil amendment interaction was not significant ($p>0.05$) for all the parameters (Table 2). Total N was highest for Riz103 and this was significantly more than that of all local cultivars and Tostado. Under local conditions, however, Riz103 is highly susceptible to the blackrot necrotic virus which may lead to 100% crop loss (Wortmann, pers. comm.). It also matures late compared to the recommended K20, an attribute which may be contributing to its higher N content. This attribute could further limit its direct adoption considering the overall dependancy on rainfed agriculture by most farmers. Mutike, despite lower N content and fixation, yielded as high the plant introductions possibly because of better adaptation to the region.

Most cultivars had less pod yield and total shoot N accumulation with P and K amendment but the reasons for this are not entirely clear. %N fixed differed between the non-fixing references (data not shown) with sorghum giving highly variable results and negative fixation for Kitinda and Tostado. Negative fixation in legumes has also been reported by Rennie (1982). %N fixation based on millet as reference apprear over-estimated as it ranged between 52 to 77% which is rather high for beans.

REFERENCES

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Table 1: Characteristics for the nine bean cultivars.

Cultivar	Seed dwt g/100seeds	Seed type[1]	Attributes	Days to flower	Days to mature
K 20	35.78	Medium	Locally bred; recommended	47 cd[2]	77 f[2]
Kitinda	45.19	Large	Local	46 d	76 g
Nkulyembaluke	33.64	Medium	Local	46 d	76 g
Mutike	32.83	Medium	Local	46 d	82 e
T-3	22.16	Small	Adapted	49 bc	89 c
White-Haricot	18.65	Small	Adapted	52 ab	89 c
Riz 103	18.75	Small	Adapted	54 a	91 a
Carioca	19.18	Small	High fixer	54 a	90 b
Tostado	33.77	Medium	High fixer	50 b	84 d

[1] <25, 25-40 and >40 g/100 seeds=small, medium and large-seeded respectively (Schoonhoven and Pastor-Corrales, 1987). [2] Means followed by the same letter within column are not significantly different ($p<0.05$; Duncan's Multiple Range test).

Table 2: Yield and N_2 fixation by the cultivars.

Cultivar		Pod yield (Kg/ha)	Total N (mg/plt)	Total N fixed with different references (mg/plt)	
				Sorghum	Millet
K20		1383.9 bc[1]	433.9 c[1]	64 bd[1]	296 c[1]
Kitinda		882.4 c	358 c	-126 d	193 c
Nkulyembaluke		1034.1 c	419.4 c	42 bd	297 c
Mutike		2331.1ab	503 bc	22 bd	320 bc
T-3		2216.1ab	598.1abc	170 ac	459 ac
White Haricot		2124.1ab	557.6abc	204 ab	423 ac
Riz 103		2876.7a	861 a	295 a	668 a
Carioca		1585.7 bc	791 ab	289 a	577 ab
Tostado		931.2 c	290.4 c	-5 cd	485 c
Means	Amended	1645.5	507.4	126.7	297.5
	Unamended	1769.1	562	85.3	462.2
%C.V.		55.61	57.05	165.42	64.10
Cultivar		***	*	***	*
Amendment		ns	ns	ns	**
Cult X Amend		ns	ns	ns	ns

[1] Means followed by same letter within column are not significantly different ($p<0.05$; Duncan's Multiple range test).